

Evaluation and Comparison of Audiometric Findings Before and After Treatment in Acute Otitis Media

Dr Kartikeya Mishra, Dr Poonam K Saidha , Dr Pooja Das* and Dr Aditi Bhawsar

Department of ENT, RAMA Medical College, Hospital and Research Institute, Kanpur, India

***Corresponding Author:** Dr Pooja Das, Department of ENT, RAMA Medical College, Hospital and Research Institute, Kanpur, India.

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Abstract

Aim: To evaluate the type of hearing loss using audiometry in acute otitis media before and after management.

Methods: All selected patients were evaluated by Otoscopy, Pure Tone Audiometry and Impedance Tympanometry at the time of presentation (Day 1) in ENT OPD, treatment was given for two weeks, and all these patients were reevaluated on 14th day of follow up by Otoscopy, Pure Tone Audiometry and Impedance Tympanometry, i.e. patients were assessed before commencement and after completion of treatment followed by evaluation and comparison of audiometric changes.

Results: After comparing the audiometric changes prior and after treatment in patients diagnosed with AOM, it was evident that acute otitis media is an inflammatory disease of the middle ear which is not only prevalent in pediatric but also in the adult age group and its diagnosis at an early stage with proper line of treatment can help to ameliorate associated hearing loss either conductive or sensorineural, as few studies have showed the spike of sensorineural hearing loss after acute bouts of otitis media

Conclusion: Acute otitis media is not only prevalent in pediatric age group but also in the adults, which is potentially curable. Medical management is the primary modality of the treatment, while surgical intervention is rarely required. Prompt diagnosis and treatment is crucial to prevent the serious sequelae and complication and permanent handicap in form of hearing loss.

Keywords: Acute Otitis Media; Tympanometry; Audiometric Changes; Otoscopy; Hearing Loss

Introduction

'Acute otitis media' (AOM) translates as acute middle ear inflammation. This inflammation typically occurs over several hours but must occur in less than 6 weeks to be classified as an acute process. It is a relatively common childhood condition and is seen less often in adults.

Clinico-pathologically it is an inflammation of the middle ear cleft of rapid onset and infective origin, associated with a middle ear effusion. Although the cause of inflammation is most typically infectious, the inflammation can also result from other etiologies

such as autoimmune, neoplastic, traumatic, and metabolic. It normally develops behind an intact tympanic membrane but may include acute infection arising in the presence of ventilation tubes or existing tympanic membrane perforation [1,2].

Microbiological, anatomical and environmental factors combine together with altered host defense mechanisms to predispose to infection. Both viral and bacterial infections are implicated. Bacterial infection accounts for the majority of adult AOM cases presenting to ENT doctors. The clinical manifestations of acute otitis media include otalgia, hearing loss, and fever. In children,

the symptoms suggestive of AOM include rapid onset of otalgia, hearing loss, otorrhoea, fever, excessive crying, irritability, coryzal symptoms, vomiting, poor feeding, ear heaviness and lethargy. Otoscopy reveals an erythematous tympanic membrane that is often bulging or ruptured with purulent drainage. Impedance tympanometry demonstrates a flat tympanogram and absent acoustic reflexes. Audiometric testing shows a conductive hearing loss [3]. It is well known fact that AOM leads to conductive hearing loss. However, recent studies have also demonstrated varying degrees of sensorineural hearing loss, especially at high frequencies, (2-8 kHz) in patients with a history of acute or recurrent AOM [4,5]. Additionally, a 30-year cohort also showed that adults with a history of recurrent childhood AOM had worse auditory thresholds [6] and a significantly higher prevalence of tinnitus [7,8], as compared to individuals with no history of AOM. Considering that the high frequencies are the most affected in AOM [9], auditory evaluation in the acute phase of the infectious process can be an important and early part of the identification of possible hearing sequel and acute complications, such as serous or suppurative labyrinthitis [4,10]. However, data regarding the evaluation of auditory alterations in the acute phase of AOM are scarce. Therefore, this study highlights to portray the hearing of AOM patients which leadsto changes in auditory thresholds (bone and air conduction) as compared to healthy ears.

Materials and Methods

Study Design: Observational Prospective study including 126 patients ranging from 8-55 years of age group diagnosed with acute otitis media who underwent clinical as well as audiometric evaluation and medically treated for the condition.

Study setting

This is a hospital based study conducted at a Department of ENT at a tertiary care hospital.

Study duration

18 months (November 2021 to April 2023).

Study variables

- Age
- Gender

- Otoscopy findings of Tympanic membrane
- Pure Tone Audiometry findings before and after treatment.

Inclusion criteria

- Patients presenting with Acute Otitis Media of both sexes and age group 8-55 years are considered for this study
- Patients who were regular for follow up visits.

Exclusion criteria

- Age of < 8years or >55 years.
- History of previous otologic disease and ear surgery.
- Hearing loss identified prior to Acute Otitis Media.
- Chronic Otitis Media.
- Malignant ear pathology.
- Patients who lost to follow up.

Statistical analysis

Statistical analysis was done using Statistical Package of Social Science (SPSS Version 22; Chicago Inc., USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. Quantitative variables were compared using mean values and qualitative variables using proportions. Significance level was fixed at $P < 0.05$.

Mcnemar's Chi-square test was used to evaluate the statistical significance of differences in frequencies between two-time interval.

Observation and Results

Total 126 patients with acute otitis media were selected for the study. Out of 126, 73(57.9%) were male and 53(42.1%) were female. Most of the patients 56(44.4%) were from 20-31 year age group, followed by patients 29(23.0%) were from 32-43 year old age group, 21(16.7%) were 44-55 year old age group and 20(15.9%) patients were 8-19 year age group (Ref. Table 1).

Most common symptom was Otolgia seen in 116 (92.1%) patients, followed by nasal symptoms which was seen in 113 (89.6%) patients. Hearing loss, aural fullness, tinnitus and otorrhoea was seen in 47 (37.3%), 44 (34.9%) 39 (30.9%), and 26 (20.7%) patients respectively (Ref. Table 2).

Age Groups	Male N (%)	Female N (%)	Total N (%)
08Y - 19Y	14(11.1%)	6(4.8%)	20(15.9%)
20Y - 31Y	26(20.6%)	30(23.8%)	56(44.4%)
32Y - 43Y	20(15.9%)	9(7.1%)	29(23.0%)
44Y - 55Y	13(10.3%)	8(6.3%)	21(16.7%)
Total	73(57.9%)	53(42.1%)	126(100.0%)
Chi Square Value	5.821		
Significance 'P' Value	0.121(NS)		

Table 1: Demographic Distribution of Study Subjects according to age and gender.

Symptoms	Number	Percentage
Otalgia	116	92.1%
Otorrhoea	26	20.7%
Hearing loss	47	37.3%
Tinnitus	39	30.9%
Aural Fullness	44	34.9%
Nasal symptoms	113	89.6%

Table 2: Incidence of Symptoms among Patients with Acute otitis media.

Tympanic membrane was evaluated at day 1 before treatment and again it was evaluated at day 14 after treatment. Total 143 ears were treated among 126 patients. Out of 143 ears, tympanic membrane was retracted non congested in 29(20.2%) at day 1 and after treatment it was seen only in 08(5.6%) patients. Retracted Congested and Bulging Congested TM was seen 14(9.8%) and 62(43.3%) at day and then after treatment, retracted congested was not seen in any patient and Bulging Congested was seen only in 01(0.69%) patient. Perforation and Discharging was seen in 38(26.6%) and after treatment, it reduced to only 02(1.39%) ears. At day 14 after treatment tympanic membrane found normal among 113(79.02%) ears (Refer to Table 3).

Hearing loss was conductive in 81 (56.64%) ear before treatment on day1 and after treatment it was seen only in 27 (18.8%). Mixed hearing loss was seen in 3 ear before treatment and on day 14 it

Otoscopy Findings (Tympanic Membrane Status)		
	AT DAY 1 (Before Treatment)	AT DAY 14 (After Treatment)
	N (%)	N (%)
Normal	00 (0.0%)	113(79.02%)
Retracted Non Congested	29(20.2%)	08(5.6%)
Retracted Congested	14(9.8%)	00(0.0%)
Bulging Congested	62(43.3%)	01(0.69%)
Perforation And Discharging	38(26.6%)	02(1.39%)
Healed Perforation	00(0.0%)	00(0.0%)
Perforation	00(0.0%)	19(13.28%)
Total	143(100.0%)	143(100.0%)
Chi Square Value	249.38	
Significance 'P' Value	0.001(HS)	

Table 3: Comparative evaluation of Otoscopy Findings (Tympanic Membrane) before and after treatment among patients with acute otitis media.

was seen only in one patient. Sensorineural hearing loss was seen in 01 (0.69%) patient before and after treatment. After medical management, 114 (79.7%) ears reverted to normal. There was statistically highly significant difference found in Audiometric Findings (TYPE OF HEARING LOSS) before and after treatment among patients with acute otitis media (P = 0.001) (Ref. Table 4).

Audiometric Findings (TYPE OF HEARING LOSS)		
	AT DAY 1 (Before Treatment)	AT DAY 14 (After Treatment)
	N (%)	N (%)
Normal	58(40.55)	114(79.7%)
Conductive	81(56.64%)	27(18.8%)
Sensorineural	01(0.69%)	01(0.69%)
Mixed	03(2.1%)	01(0.69%)
Total	143(100.0%)	143(100.0%)
Chi Square Value	47.75	
Significance 'P' Value	0.001(HS)	

Table 4: Comparative evaluation of Audiometric Findings before and after treatment among patients with acute otitis media.

On day 1, degree of hearing loss was mild and moderate among 74 (51.7%) and 09 (6.3%) ear before treatment while at day 14 after treatment, it was seen only in 23 (16.1%) and 03 (2.1%) ear respectively. There was statistically highly significant difference found in Audiometric Findings (DEGREE OF HEARING LOSS) before and after treatment among patients with acute otitis media (P = 0.001) (Ref. Table 5).

Audiometric Findings (DEGREE OF HEARING LOSS)		
	AT DAY 1 (Before Treatment)	AT DAY 14 (After Treatment)
	N (%)	N (%)
Normal	58(40.5%)	113(79.02%)
Mild	74(51.7%)	23(16.1%)
Moderate	09(6.3%)	03(2.1%)
Moderately Severe	00(0.0%)	04(2.8%)
Severe	02(1.4%)	00(0.0%)
Profound	00(0.0%)	00(0.0%)
Total	143(100.0%)	143(100.0%)
Chi Square Value	53.5	
Significance 'P' Value	0.001(HS)	

Table 5: Comparative evaluation of Audiometric Findings (DEGREE OF HEARING LOSS) before and after treatment among patients with acute otitis media.

On day 1 type A, B and C curve was seen in 19 (13.3%), 94 (65.7%) and 30 (20.9) ears respectively while after treatment it was seen in 113 (79.02%), 28 (19.5%) and 02 (1.4%) respectively. As and Ad type was not seen in tympanometry. There was statistically high significant difference found in tympanometry findings before and after treatment among patients with acute otitis media (P = 0.001) (Ref. Table 6).

Acoustic reflex was present in 20 (13.99%) ear on day 1 while after 14 days of treatment, it was seen in 112 (78.32%). There was statistically highly significant difference found in Audiometric Findings (ACOUSTIC REFLEX) before and after treatment among patients with acute otitis media (P = 0.001) (Ref. Table 7).

Audiometric Findings (Tympanometry)		
	AT DAY 1 (Before Treatment)	AT DAY 14 (After Treatment)
	N (%)	N (%)
A Type	19(13.3%)	113(79.02%)
B Type	94(65.7%)	28(19.5%)
C Type	30(20.9)	02(1.4%)
As Type	00(0.0%)	00(0.0%)
Ad Type	00(0.0%)	00(0.0%)
Total	143(100.0%)	143(100.0%)
Chi Square Value	127.14	
Significance 'P' Value	0.001(HS)	

Table 6: Comparative evaluation of Audiometric Findings (Tympanometry) before and after treatment among patients with acute otitis media.

Audiometric Findings (ACOUSTIC REFLEX)		
	AT DAY 1 (Before Treatment)	AT DAY 14 (After Treatment)
	N (%)	N (%)
ABSENT	123(86.01%)	31(21.67%)
PRESENT	20(13.99%)	112(78.32%)
Total	143(100.0%)	143(100.0%)
Chi Square Value	116.51	
Significance 'P' Value	0.001(HS)	

Table 7: Acoustic Reflex of patients before and after treatment.

Discussion

Acute otitis media is the most common diagnosis made in children next to the common cold. The majority of children will be diagnosed with at least one episode of acute otitis media with rates of incidence peaking at 2 years. Although it is considered as a pediatric medical problem, acute otitis media also presents in the adolescent and adult population, though at a lower rate.

Age and gender

In our study most of the patient (44.4%) were of age between 20-30 years, while 16.7%, 15.9% and 23% were lying in 8-19 year,

44-55 years and 32-43 year age groups respectively, indicating that disease is more common in young adults. In contrast to Rettig, *et al.* [11] and Michael, *et al.* [12] observed most cases of AOM in young children ages 6 to 24 months, with the incidence of AOM declining significantly after age 5. A 2005 global disease burden modeling-based study by Lorenzo Monasta, *et al.* [13] observed AOM most common in children under age 5 years, followed by children aged 5 to 14 years, children and adults aged 15 to 24 year and adults aged 25-85 years. In our study the age below 8 years and above 55 years were kept in exclusion criteria, due to difficulty in performing pure tone audiometry in children and age-related hearing loss as a confounding factor in geriatric age group.

In our study, 57.9% were male and 42.1% were female patient which is in correlation with Reddy, *et al.* [14] study in which boys are frequently affected than girls, which may be a reflection of anatomical or growth differences or the overall male predominance for childhood infections. However, the difference found in demographic distribution of patients with acute otitis media according to age and gender was statistically not significant.

Symptoms

AOM classically have short history, and is generally associated with otalgia, fever, otorrhoea, irritability, lethargy. Tympanometry alone is a useful screening tool in investigating otitis media [15].

Most common symptom in our study was otalgia seen in 92.1% patients. Hearing loss, aural fullness, tinnitus and otorrhoea was seen in 37.3%, 34.9%, 30.9%, and 20.7% patients respectively. In correlation with Mozaffarinia, *et al.* [16] who found most common symptoms were periodic otalgia, aural fullness, and hearing loss. Second most common was nasal symptoms found in 89.6% patients which is also in correlation with Eden b., *et al.* [17], in which acute otitis media is frequently preceded by an upper respiratory infection.

Otosopic examination

Pneumatic otoscopy is the primary diagnostic tool to evaluate the status of the middle ear as it allows direct visualization of the TM and its mobility.

In our study, on otoscopic examination we found that bulging and congested tympanic membrane was most common sign seen

in 43.3% ears on day 1, which is on the day when patient firstly presented to us. Perforation and discharging were seen in 26.6% followed by retracted non congested, retracted congested in 20.2% and 9.8% respectively. While in contrast Kasemodel AL, *et al.* [18], observed hyperemia, and tympanic membrane perforation on otoscopy and Sharma, *et al.* [19], found dull and retracted TM in most of the ears.

Out of 100%, 79.02% ears reverted back to normal finding in our study. Remaining subjects showed retracted non congested, perforation and discharging, bulging and congested ears in 5.6%, 1.39% and 0.69% ears respectively. In 13.28% ears, perforation was present after medical management. McCormick, *et al.* [20] observed that patients with bilateral AOM are more likely to have persistent symptoms if not treated with antimicrobials. In Farrior J., *et al.* [21] study, over 90% of acute perforation heal spontaneously within two months. There was statistically highly significant improvement was seen after treatment in patients with acute otitis media after treatment in our study.

Audiometric findings

Acute otitis media can result in permanent auditory sequelae and the resulting hearing complaints are often undervalued [22].

Hearing assessment can be done using tuning fork tests in and can be confirmed with PTA in older patients. Audiometry will give a quantitative and qualitative assessment of hearing.

Among the 143 assessed ears on day 1, conductive deficits were predominant 56.64% ears with presence of mixed hearing loss in 2.1% of the sample, and the presence of a sensorineural component seen only in 0.69% patient. After medical management, 79.7% ears reverted back to normal hearing with residual conductive deficit in 18.8%, mixed and sensorineural deficit seen in 0.69% ear each. Swart, *et al.* [23] also reported an incidence of SSSL with AOM of 8%.

In our study, mild degree of hearing loss was seen in most of the (51.7%) patients before treatment. Further moderate and severe hearing loss found in 06.3% and 1.4% ears respectively. After medical treatment, 113 ears reverted back to normal with residual hearing loss of mild, moderate and moderately severe in 23(16.1%), 03(2.1%) and 04(2.8%) ears. There was statistically

highly significant difference found in audiometric findings (Type and degree of hearing loss) before and after treatment among patients with acute otitis media ($P = 0.001$).

Tympanogram showing B curve is suggestive of fluid in the middle ear and is diagnostic of OM and C type curve is suggestive of negative pressure within the middle ear. In our study on day 1, type B curve was most common seen in 65.7% ears followed by type C and type A curve in 20.9% and 13.3% respectively. After medical management on day 14, 79.02% ears reverted back to normal that is type A curve with type B and C curve in 19.5% and 1.4% respectively. On impedance audiometry, Sharma, *et al.* [19] observed Type A, Type B, and Type C curve in 34.5%, 50.17%, and 15.33% ears respectively.

In our study, acoustic reflex was absent in 86.01% ears on day 1 while after 14 days of treatment, it was present in 78.32% ears. There was statistically highly significant difference found in tympanometry findings before and after treatment among patients with acute otitis media ($P = 0.001$).

Conclusion

Acute otitis media' (AOM) is a relatively common childhood condition and is seen less often in adults, and that too in male population as compared to female, but, in contrast to this, in our study, we have found that acute otitis media is not an uncommon disease in adult age group, also there is no statistically significant difference found in relation to gender in our study. Being an acute inflammatory process the symptoms consistent with acute inflammation were found. Otalgia being the commonest followed by nasal symptoms, hearing loss, aural fullness, tinnitus and purulent otorrhea in that order.

In our study, the commonest otoscopic finding was congested and bulging tympanic membrane, followed by perforated drum with active discharge. Some had some residual hearing loss with perforation after completion of 2 weeks of treatment. On audiometric evaluation conductive type of hearing loss was most common finding, followed by mixed hearing loss, while the pure sensorineural hearing loss was found only in one patient. Similarly the degree of hearing loss, was also significantly improved after the treatment. In our study type B curve was most common seen followed by type C and type A curve. After medical management

most of the ears reverted back to normal. Statistically significant changes in tympanometric findings and acoustic reflex before and after treatment were also found in our study.

From the observation and results obtained from this study, we can conclude that acute otitis media is an inflammatory disease process of the middle ear which is not only prevalent in pediatric age group but also in the adult age group, which is potentially curable. Medical management is the primary modality of the treatment, while surgical intervention is rarely required. Prompt diagnosis and treatment is crucial to prevent the serious sequelae and complication and permanent handicap in form of hearing loss.

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